

CLAIMS

1 1. A plasma chamber comprising:

2 a vacuum chamber enclosure enclosing a chamber interior;

3 a gas inlet aperture for admitting a gas into the chamber interior;

4 a plasma excitation power source for coupling energy to the gas so as to excite at least a portion
5 of the gas to produce a plasma within the chamber interior;

6 an exhaust pump;

7 an exhaust channel extending between the chamber interior and the exhaust pump so as to
8 provide a path for gas flow from the chamber interior to the exhaust pump;

9 a deflector positioned within the exhaust channel so as to create turbulence in said gas flow
10 through the exhaust channel; and

11 a magnet system having north and south magnetic poles positioned adjacent the deflector.

1 2. A plasma chamber according to claim 1, wherein the magnet system produces a magnetic field
2 strong enough to block said plasma from extending from the chamber interior to the exhaust pump.

1 3. A plasma chamber according to claim 1, further comprising:

2 a chuck for holding a substrate at a substrate position within the chamber interior;

3 wherein the magnet system is positioned far enough from the substrate position so that the
4 magnet system does not produce a magnetic field greater than 5 gauss at the substrate position.

1 4. A plasma chamber according to claim 1, wherein:

2 the magnet system has an annular shape and is positioned coaxially with the exhaust channel.

1 5. A plasma chamber according to claim 1, wherein:

2 the north and south magnetic poles are spaced apart along said gas flow path.

1 6. A plasma chamber according to claim 1, wherein:

2 the north and south magnetic poles are positioned on opposite sides of said gas flow path so as

3 to produce a magnetic field transverse to said gas flow path.

1 7. A plasma chamber comprising:

2 a vacuum chamber enclosure enclosing a chamber interior;

3 a gas inlet aperture for admitting a gas into the chamber interior;

4 ^{Sub B3} a plasma excitation power source for coupling energy to the gas so as to excite at least a portion
5 of the gas to produce a plasma within the chamber interior;

6 an exhaust pump;

7 ^{Sub B3} an exhaust channel extending between the chamber interior and the exhaust pump so as to
8 provide a path for gas flow from the chamber interior to the exhaust pump;

9 a deflector positioned within the exhaust channel so as to transversely deflect a substantial
10 portion of said gas flow through the exhaust channel; and

11 a magnet system having north and south magnetic poles positioned adjacent the deflector.

1 8. A plasma chamber according to claim 7, wherein:

2 the exhaust channel comprises

3 an inlet aperture in fluid communication with the chamber interior,

4 an outlet aperture in fluid communication with the pump, and

5 at least a first wall that extends between the inlet aperture and the outlet aperture;

6 the deflector comprises a protrusion extending from the first wall of the exhaust channel into

7 the exhaust channel so as to reduce the transverse width of the exhaust channel adjacent the protrusion;

8 and

9 the north and south poles of the magnet system are positioned within the protrusion.

1 9. A plasma chamber according to claim 8, wherein:

2 the pump produces a flow of gas from the chamber interior, through a gas flow path within the

3 ^{Sub B4} exhaust channel, and to the pump; and

4 the north and south magnetic poles are spaced apart along said gas flow path.

1 10. A plasma chamber according to claim 8, wherein the magnet system produces a magnetic field
strong enough to block said plasma from extending from the chamber interior through the exhaust
channel beyond the protrusion.

1 11. A plasma chamber according to claim 8, further comprising:
2 a chuck for holding a substrate at a substrate position within the chamber interior;
3 wherein the magnet system is positioned far enough from the substrate position so that the
4 magnet system does not produce a magnetic field greater than 5 gauss at the substrate position.

1 12. A plasma chamber according to claim 8, wherein:
2 the protrusion has an annular shape and is positioned coaxially with the exhaust channel; and
3 the magnet system has an annular shape and is positioned coaxially with the exhaust channel.

1 13. A plasma chamber, comprising:
2 a vacuum chamber enclosure enclosing a chamber interior;
3 a gas inlet aperture for admitting a gas into the chamber interior;
4 a plasma excitation power source for coupling energy to the gas so as to excite at least a portion
5 of the gas to produce a plasma within the chamber interior;
6 an exhaust pump;
7 an exhaust channel including
8 an inlet aperture in fluid communication with the chamber interior,
9 an outlet aperture in fluid communication with the pump, and
10 at least a first wall that extends between the inlet aperture and the outlet aperture; and
11 a magnet system having north and south magnetic poles positioned adjacent the first wall;
12 wherein the plasma chamber does not include any other magnet adjacent said magnet system.

1 14. A plasma chamber according to claim 13, wherein:
2 the pump produces a flow of gas from the chamber interior, through a gas flow path within the
3 exhaust channel, and to the pump; and
4 the north and south magnetic poles are spaced apart along said gas flow path.

1 15. A plasma chamber according to claim 13, wherein:
2 the north and south magnetic poles are adjacent a first area of the first wall; and
3 the magnet system produces a magnetic field strong enough to block said plasma from
4 extending from the chamber interior through the exhaust channel beyond said first area.

1 16. A plasma chamber according to claim 13, further comprising:
2 a chuck for holding a substrate at a substrate position within the chamber interior;
3 wherein the magnet system is positioned far enough from the substrate position so that the
4 magnet system does not produce a magnetic field greater than 5 gauss at the substrate position.

1 17. A magnet system comprising:
2 a cylindrical, magnetically permeable pole piece having first and second axially opposite ends;
3 an annular first magnet having north and south poles at radially inner and outer ends,
4 respectively, wherein the first magnet is positioned coaxially with the pole piece so as to abut the first
5 end of the pole piece; and

6 an annular second magnet having south and north poles at radially inner and outer ends,
7 respectively, wherein the second magnet is positioned coaxially with the pole piece so as to abut the
8 second end of the pole piece.

1 18. A magnet system according to claim 17, wherein:
2 the outer end of the first magnet abuts the pole piece; and
3 the outer end of the second magnet abuts the pole piece.

1 19. A magnet system according to claim 17, wherein:
2 the inner end of the first magnet abuts the pole piece; and
3 the inner end of the second magnet abuts the pole piece.

1 20. A magnet system according to claim 17, wherein the exhaust channel has an annular shape and the
2 first wall provides a radially inner boundary of the exhaust channel.

1 21. A magnet system according to claim 17, wherein the exhaust channel has an annular shape and the
2 first wall encircles the exhaust channel.

1 22. A magnet system according to claim 17, wherein the exhaust channel has a generally cylindrical
2 shape and the first wall encircles the exhaust channel.

1 23. A magnet system comprising:
2 a cylindrical magnet having north and south poles at axially opposite ends of the magnet;
3 a first magnetically permeable pole piece that is annular in shape and is positioned coaxially
4 with the magnet so as to abut the north pole of the magnet; and
5 a second magnetically permeable pole piece that is annular in shape and is positioned coaxially
6 with the magnet so as to abut the south pole of the magnet.

1 24. A magnet system according to claim 23, wherein:
2 the first pole piece has a radially outer end that abuts the north pole of the magnet; and
3 the second pole piece has a radially outer end that abuts the south pole of the magnet.

1 25. A magnet system according to claim 23, wherein:
2 the first pole piece has a radially inner end that abuts the north pole of the magnet; and
3 the second pole piece has a radially inner end that abuts the south pole of the magnet.

1 26. A method of preventing the plasma within a plasma chamber from extending through the exhaust
2 channel of the chamber to the exhaust pump, comprising the steps of:
3 providing a vacuum chamber enclosure that encloses a chamber interior;
4 admitting a gas into the chamber interior;
5 coupling energy to the gas so as to excite at least a portion of the gas to produce a plasma
6 within the chamber interior;
7 providing an exhaust channel extending between the chamber interior and an exhaust pump so
8 as to provide a path for gas flow from the chamber interior to the exhaust pump;
9 positioning a deflector within the exhaust channel so as to create turbulence in said gas flow

10 through the exhaust channel; and
11 creating a magnet field within the exhaust channel having a substantial component that is
12 transverse to said gas flow path.

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1 27. A method according to claim 26, wherein the creating step comprises:
2 creating said magnetic field with sufficient strength to block said plasma from extending from
3 the chamber interior to the exhaust pump.

1 28. A method according to claim 26, further comprising the step of:
2 holding a substrate at a substrate position within the chamber interior;
3 wherein the creating step comprises creating said magnetic field with a strength that diminishes
4 sufficiently from the exhaust channel to the substrate position so that said magnetic field is no greater
5 than 5 gauss at the substrate position.

1 29. A method according to claim 26, wherein the creating step comprises:
2 positioning an annular magnet system coaxially with the exhaust channel.

1 30. A method according to claim 26, wherein the creating step comprises:
2 positioning a magnet system adjacent the exhaust channel so that north and south magnetic
3 poles of the magnet system are spaced apart along said gas flow path.

1 31. A method according to claim 26, wherein the creating step comprises:
2 positioning a magnet system adjacent the exhaust channel so that north and south magnetic
3 poles of the magnet system are positioned on opposite sides of said gas flow path so as to produce a
4 magnetic field transverse to said gas flow path.